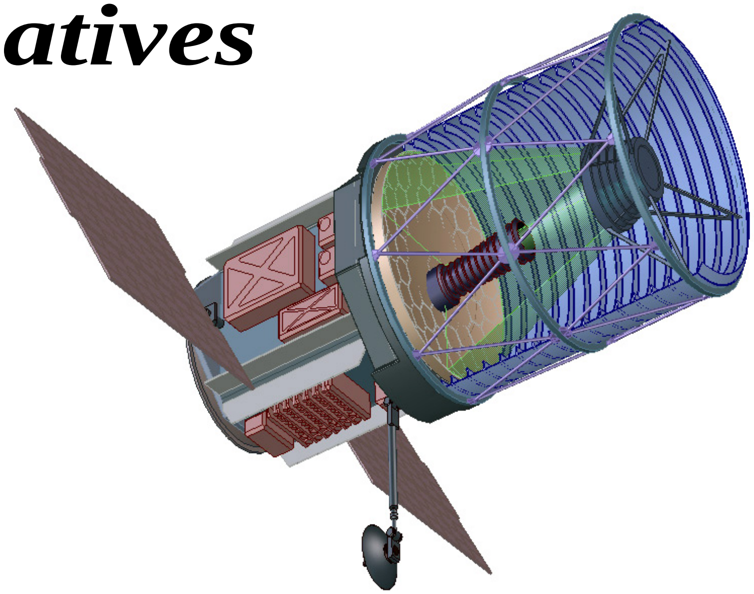
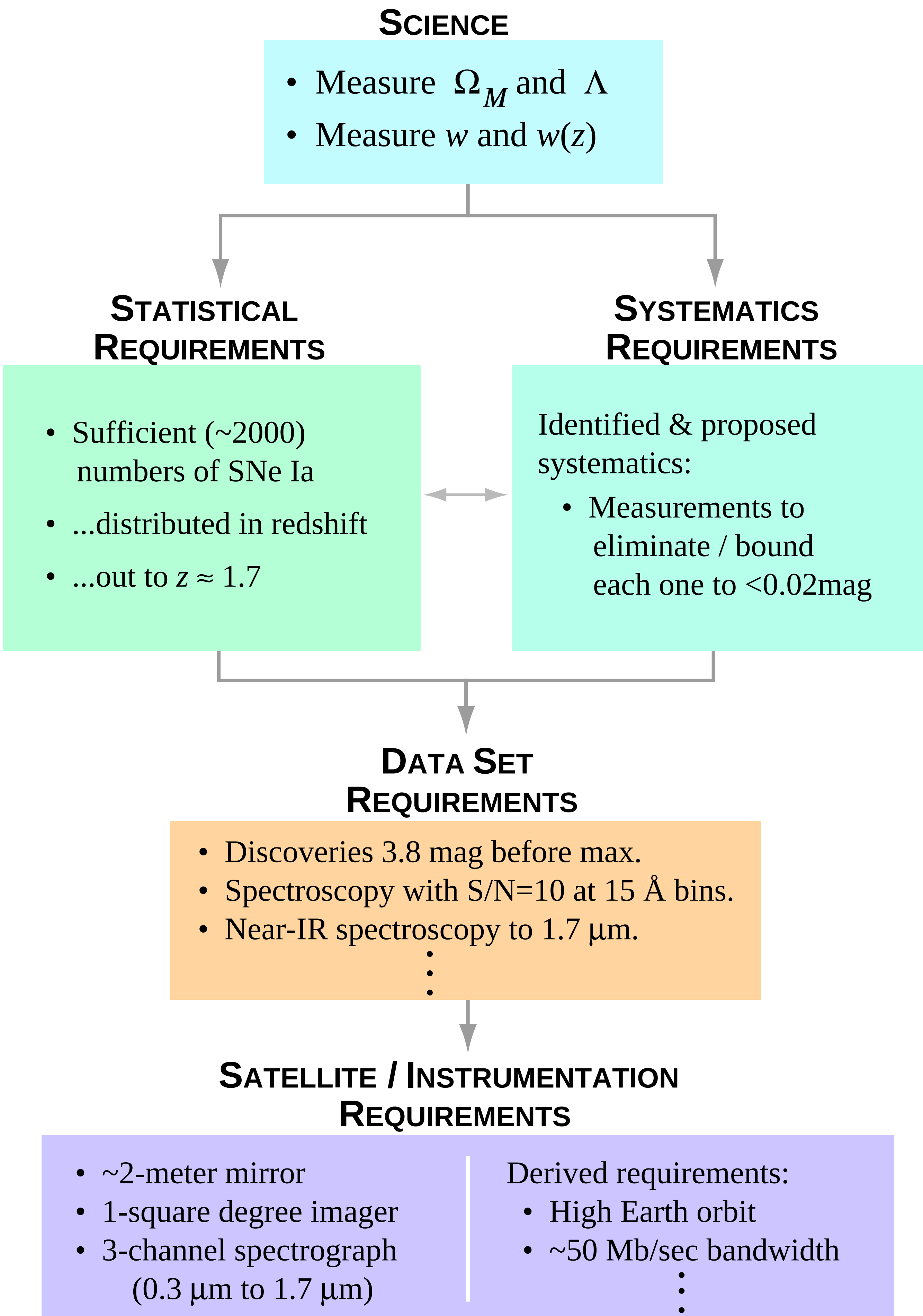
Systematics & Alternatives - Preview



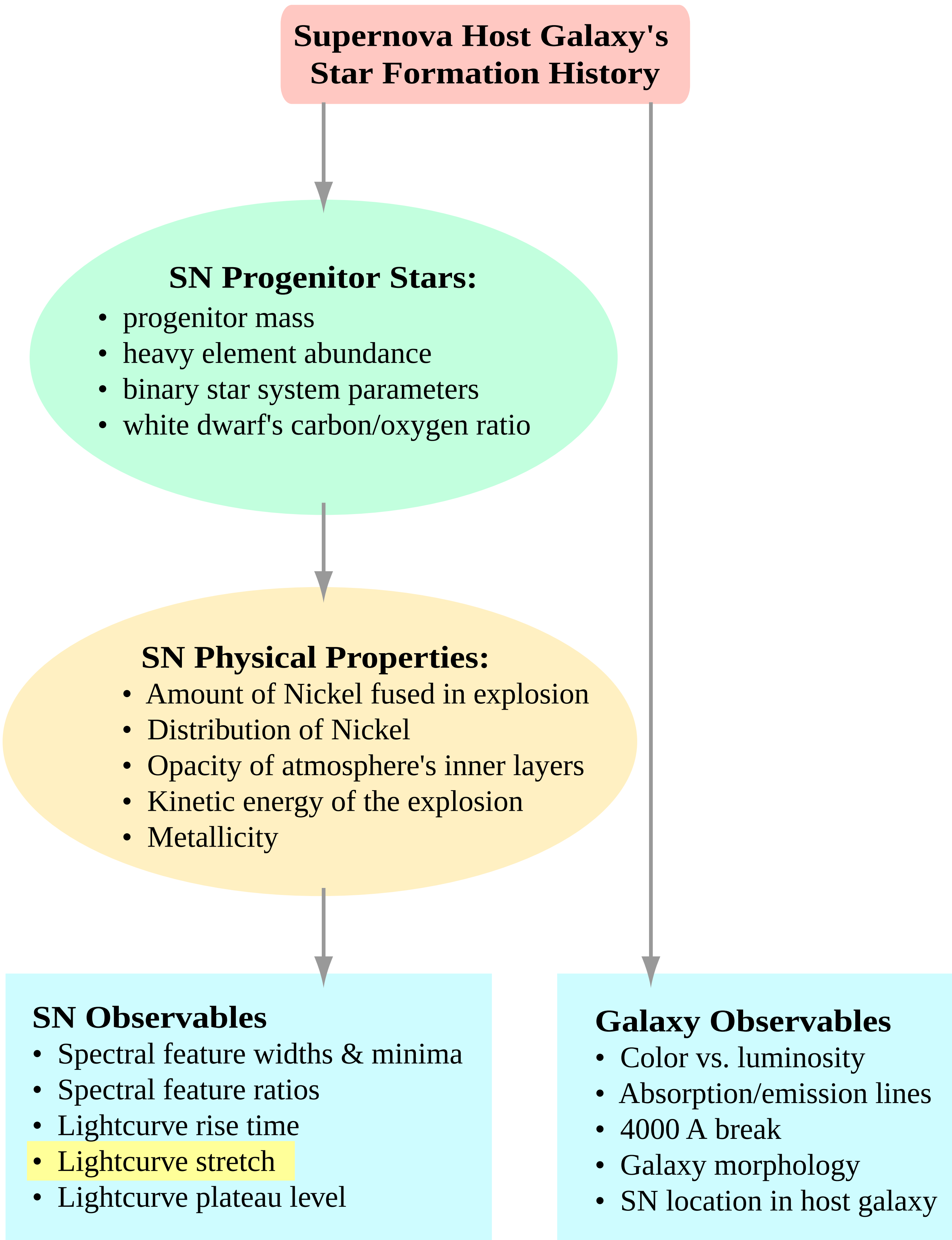
- Control of Identified Systematics with *SNAP*
- Control of Proposed Systematics with *SNAP*
- Comparison with Alternative Facilities


Science
Measure Ω_M and Λ
Measure w and $w(z)$
Statistical Requirements
Sufficient (~2000) numbers of SNe Ia
...distributed in redshift
...out to $z \approx 1.7$
Systematics Requirements
Identified & proposed systematics:
Measurements to eliminate / bound each one to <0.02mag
Data Set Requirements
Discoveries 3.8 mag before max.
Spectroscopy with S/N=10 at 15 Å bins.
Near-IR spectroscopy to 1.7 μm.
Satellite / Instrumentation Requirements
~2-meter mirror
1-square degree imager
3-channel spectrograph (0.3 μm to 1.7 μm)
Derived requirements:
High Earth orbit
~50 Mb/sec bandwidth

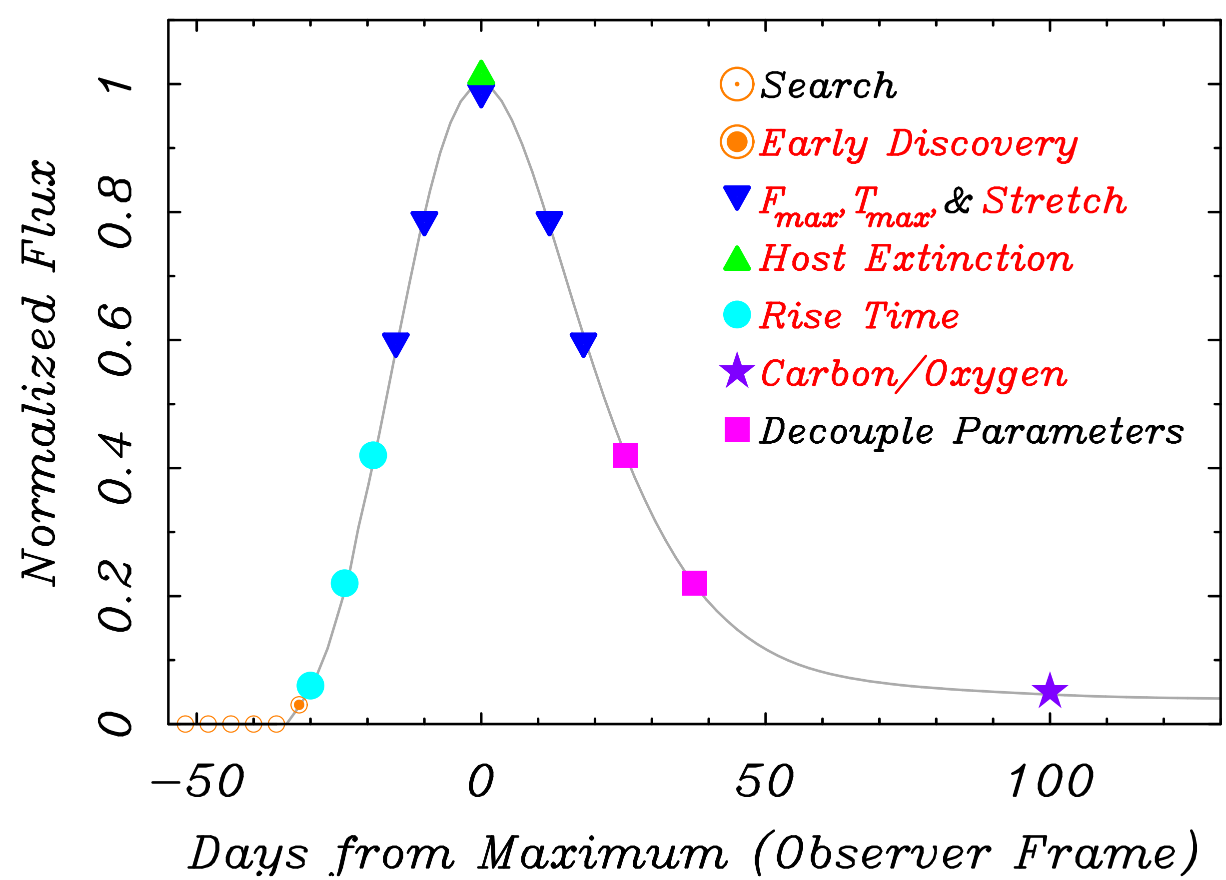
Identified Systematic Uncertainties become Negligible or Statistical Uncertainties

Systematic	Current δM	Requirement to satisfy $\delta M < 0.02$
Malmquist bias	0.04	Detection of every supernova well below peak over entire redshift range
K-Correction and Cross-Filter Calibration	0.03	Spectral time series of representative SN Ia and cross-wavelength relative flux calibration
Non-SN Ia Contamination	< 0.05	Spectrum for every supernova at maximum covering the rest frame Si II 6150Å feature
Milky Way Galaxy extinction	< 0.04	SDSS & SIRTF observations; SNAP spectra of Galactic subdwarfs
Gravitational lensing by clumped mass	< 0.06	Average out the effect with large statistics ($\sim$ 75 SNe Ia per 0.03 redshift bin). SNAP microlensing measurements.
Extinction by "ordinary" dust outside the Milky Way	0.03+	Optical+NIR calibrated spectra to observe wavelength dependent absorption

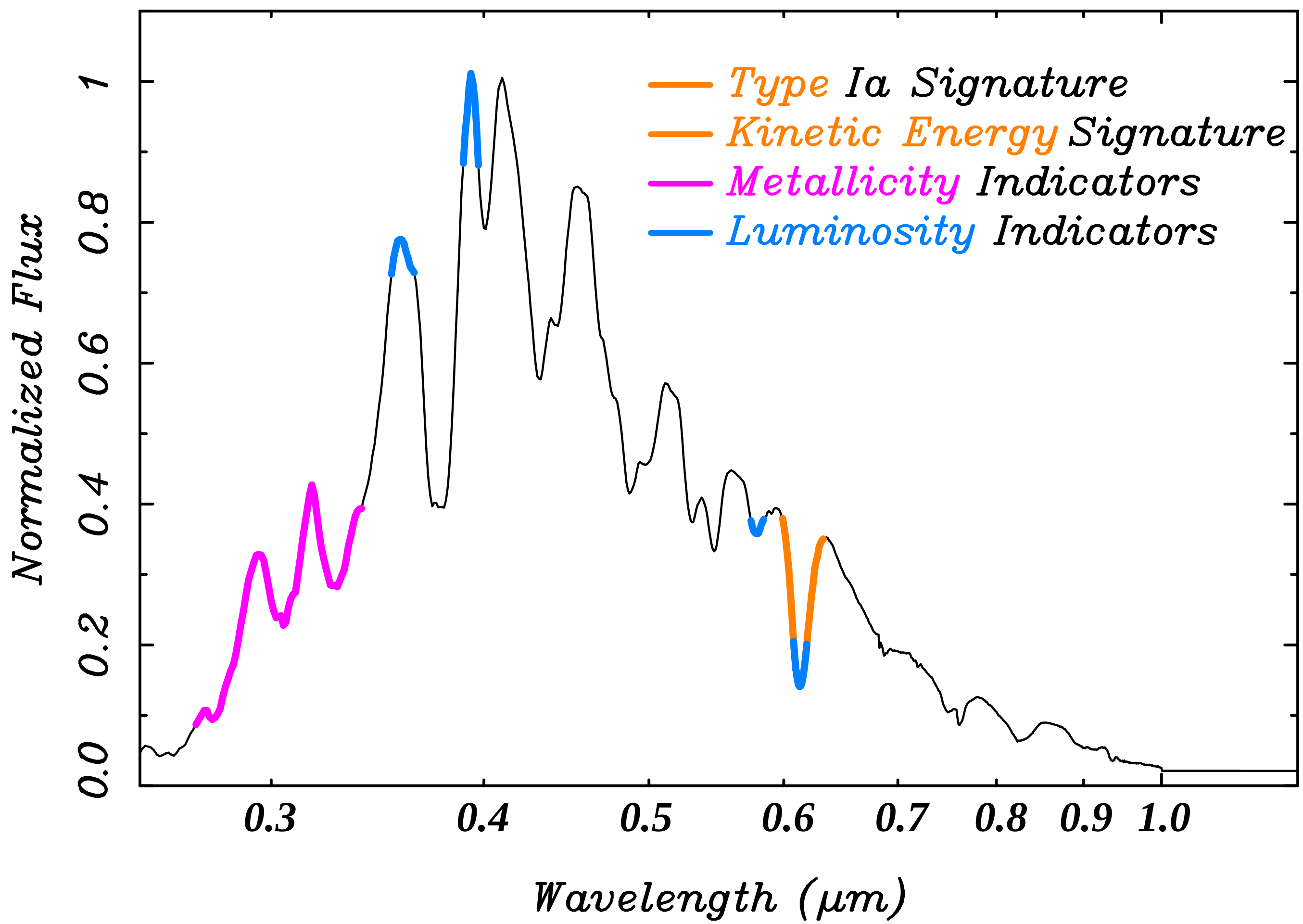
Control of Evolution Systematics: Matching Supernovae



B−band Lightcurve Photometry for z = 0.8 Type Ia

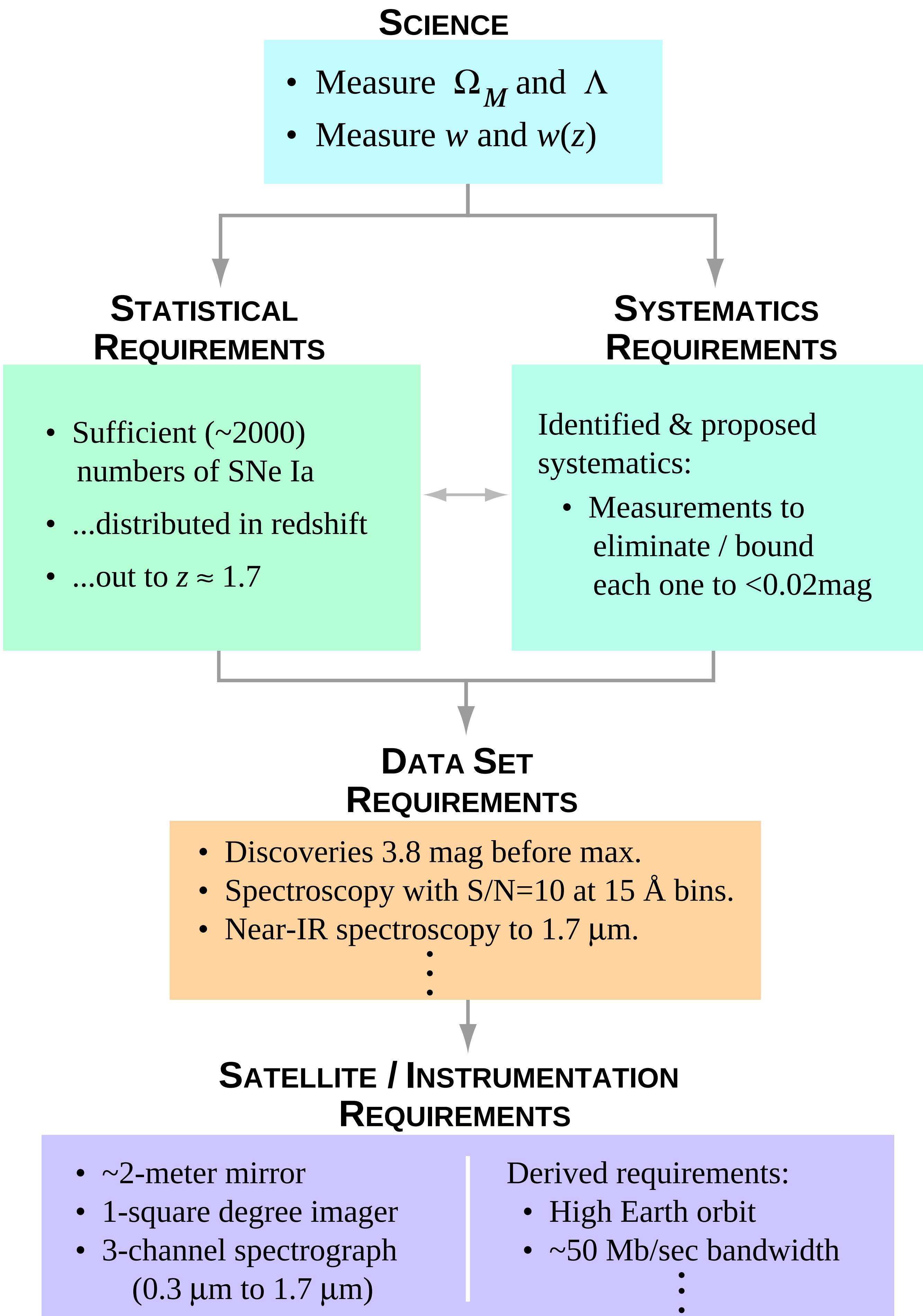


Type Ia Spectral Features



Proposed Systematic — Intergalactic Grey Dust

- Dust emission from galaxies can already account for most the the FIR background, so amount of intergalactic dust is limited.
- $z = 1.2$ SN Ia observations favor $\Lambda > 0$ over grey dust.
- IR color measurements of $z \sim 0.5$ SN Ia favor $\Lambda > 0$ over grey dust.
- Better constraints to come from IR colors of very early Type II SNe.
- *SNAP* dataset (especially NIR data to 1.7 μm) allows correction for any physically plausible dust.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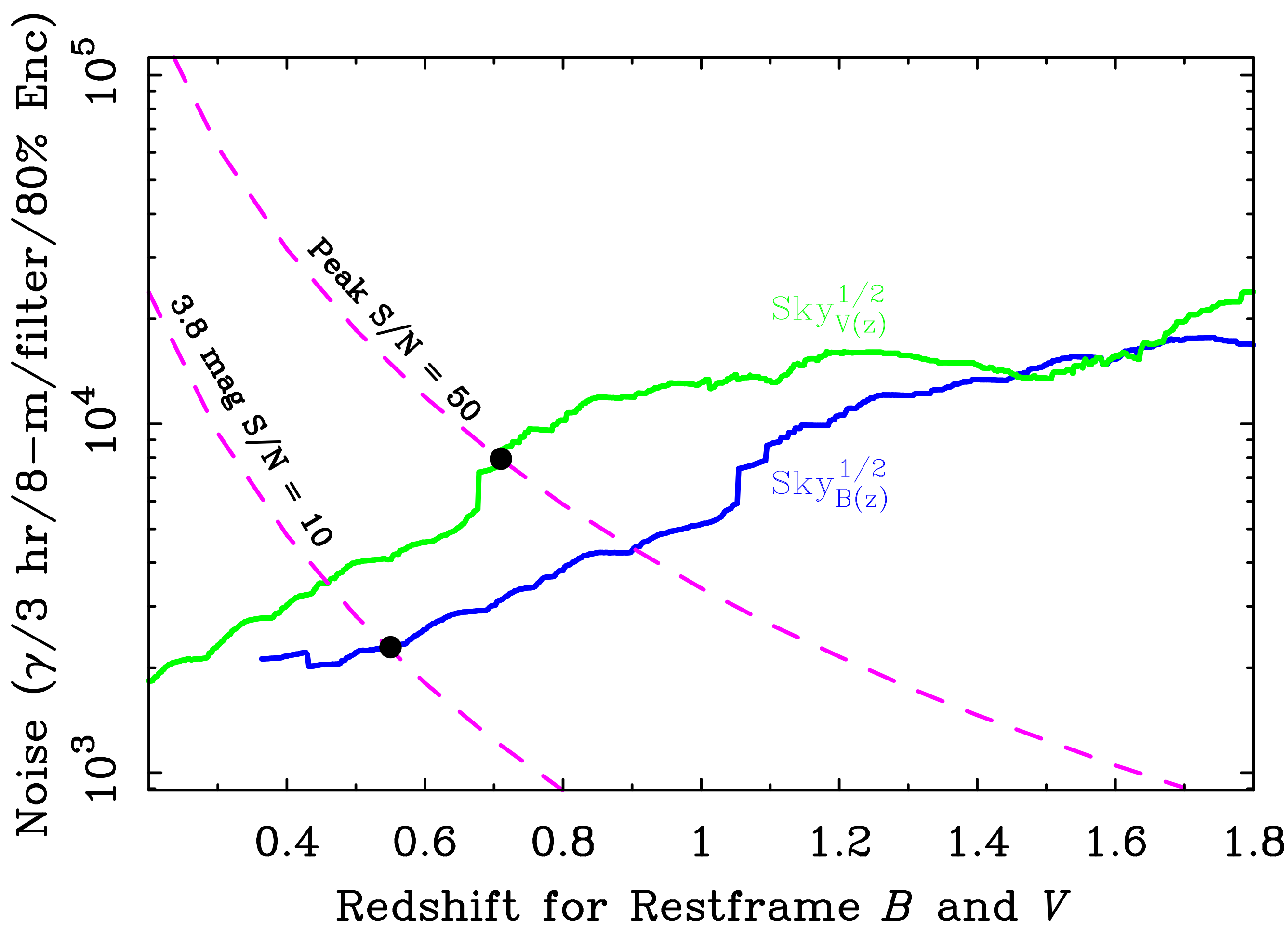
SNAP Systematics Control Summary

- Identified systematics become negligible or statistical
- SNe lightcurves and spectra determine initial conditions
- SNe can be matched over $0 < z < 1.7$
- SN homogenization can likely be refined with additional observables
- The amount of Intergalactic Dust can be constrained with FIR Background
- Properties of Dust with z can be measured with SNe II
- *SNAP* dataset enables correction for physically plausible dust.

SNAP can keep Systematic Uncertainties under 2%

Sky Photon Noise: Ground 8-meter, 3 hr



If problems with Adaptive Optics photometry can be solved,

Can Ground-Based AO do better than SNAP?

Case 1: AO on a Big Ground-Based Telescope

- AO on large aperture telescope can correct a very small region around SN.
- *But, searching & lightcurve require wide field to obtain large multiplex advantage.*

Case 2: AO on a Ground-Based Telescope Array

- Array of tip-tilt corrected 1-meter telescopes can improve large field.
- *But, large "skirt" of tip-tilt PSF negates advantage for accurate photometry.*

Why not Wait and Use NGST?

- *SNAP* field of view is 225$\times$ that of *NGST*.
- *NGST* pointing time is $\sim$ 20 minutes.
- Pointing time to cover one *SNAP* field is $\sim$ **38 hours!**
- Pointing time to cover 20$\square^\circ$ is $\sim$ **31 days!**

$\therefore$ ***NGST* is an order of magnitude too slow to keep up with discovery & follow-up.**

Summary & Conclusion

- SNAP provides an accurate, complete, and homogeneous dataset.
- This dataset allows unprecedented control over current and proposed systematic uncertainties.
- The SNAP dataset cannot be obtained with other reasonable combination of current or planned facilities, on the ground or in space.

SNAP is an ideal mission for making Supernovae one of the Pillars of Observational Cosmology.